Critical Vunerability & Forward Pixel DCS Alarms

- Local Alarms - Alarms that are concern to the effective operation of the pixel detector but are not threatening to the CMS experiment as a whole.

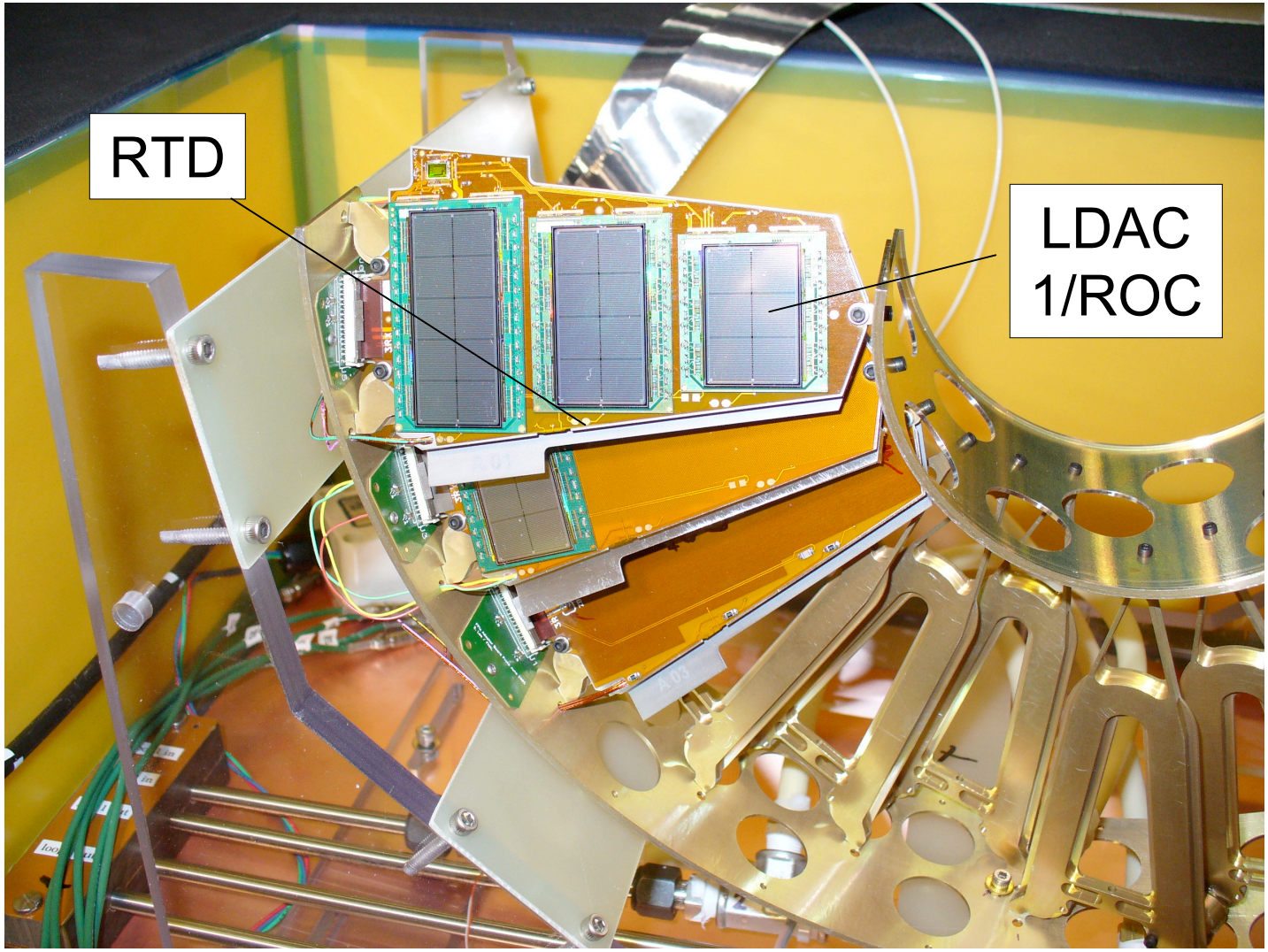
- Global Alarms- Alarms that are devastating to the operation of the pixel detector and may be threatening to the experiment as a whole.

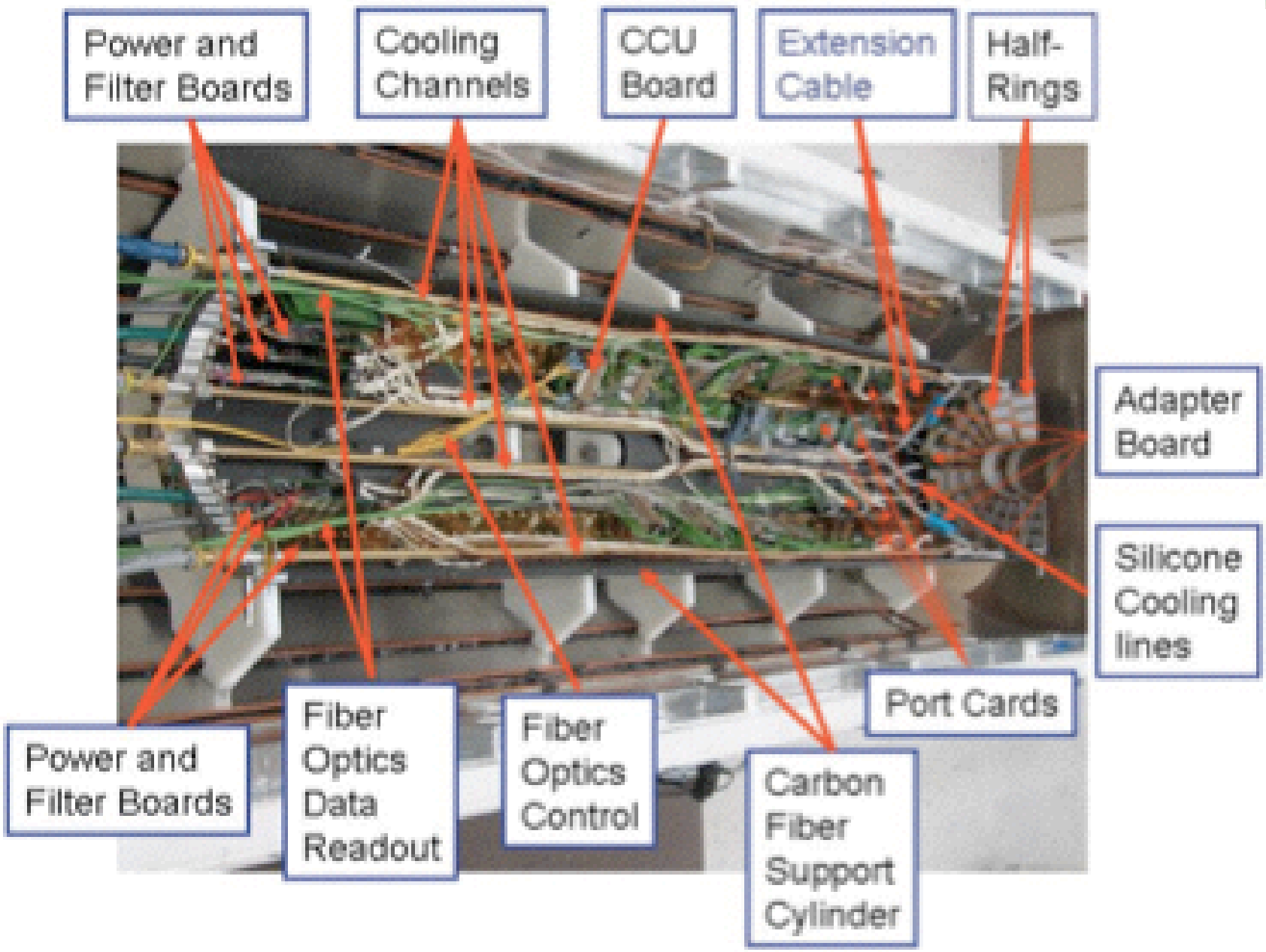
- DSS- CMS Detector Safety System Fire, Smoke, Beam Accidents, Water, Personal Safety, Electrical Safety,Mechanical Failure

DCS Actions:

1) Ramp HV down, Ramp LV down - PLC, Manual.
2) Request Cooling plant change - Manual.

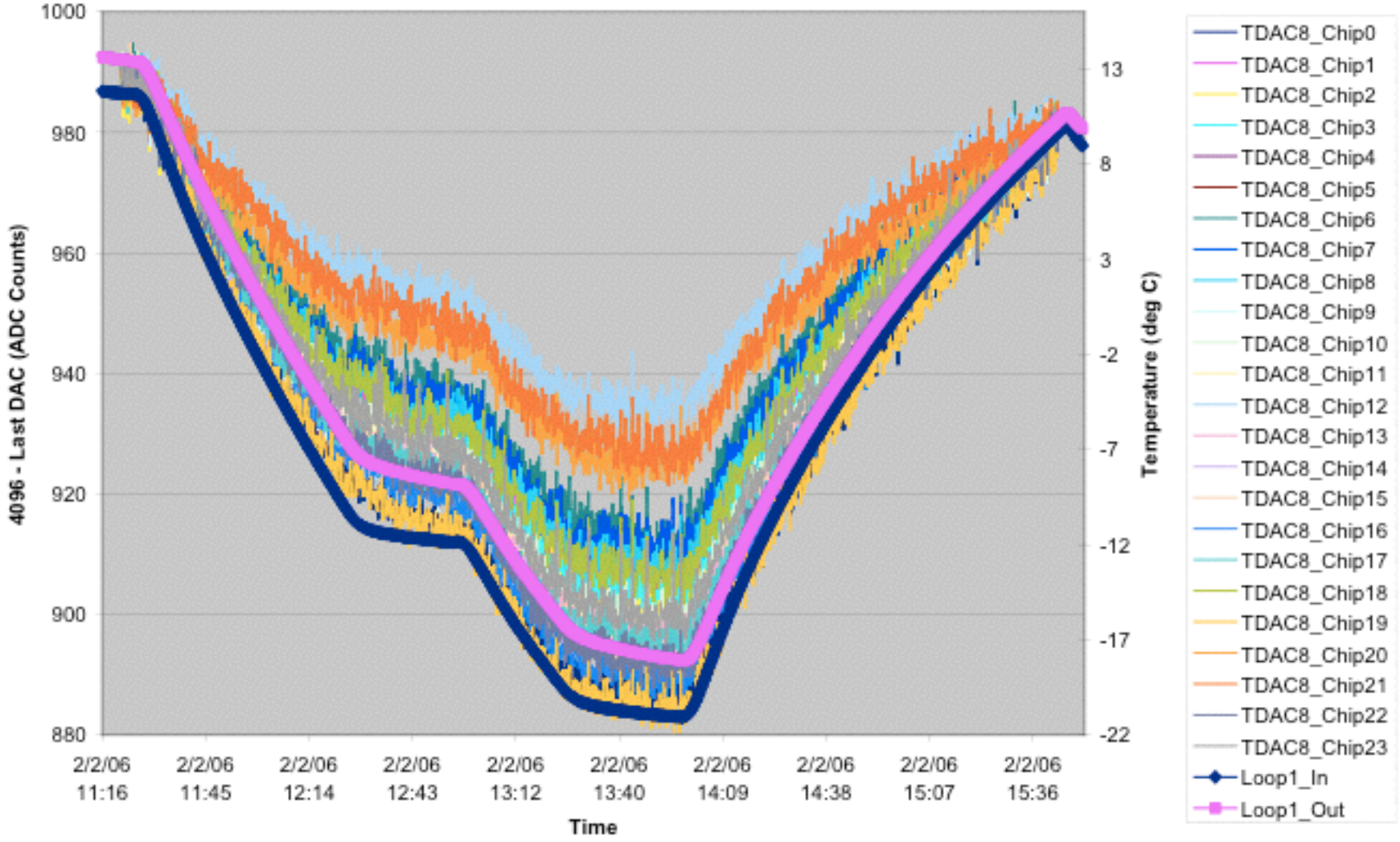
PANEL TEMPERATURE



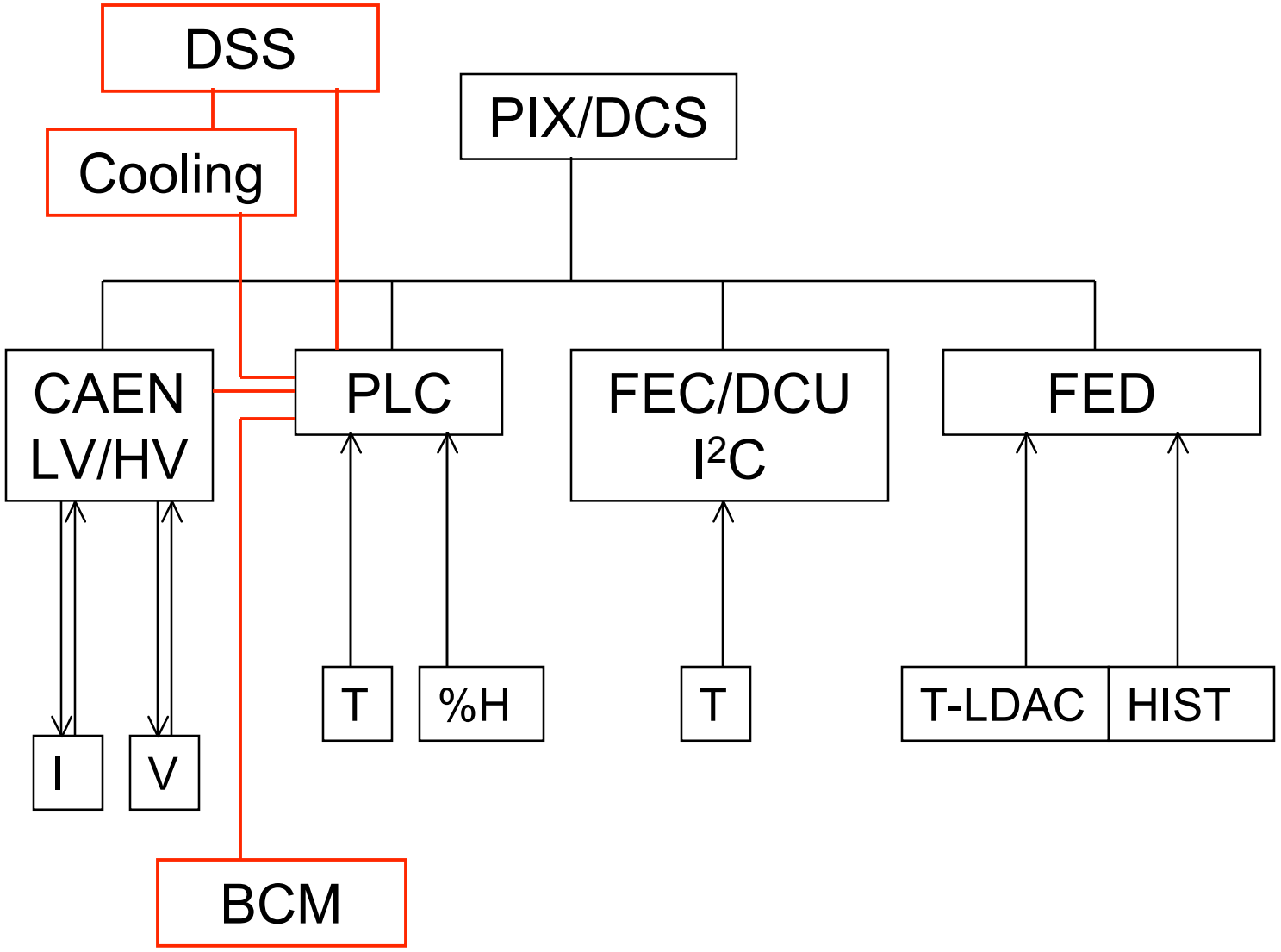


L. Cremaldi, FPIX Critical Vunerability Review, Fermilab 5-30-50

Last DAC - Embedded T-Sensor on Pixel Readout Chip



DCS Architecture



Local Alarms

Problem (Local)	Effect	Siemens T / %H	FEC/DCU Temp	FED Temp/Rate	Chiller Flow/Wght	CAEN I-V	Action
6-U cooling loop failure (small leak)	Small temperature drift. May be detected by N2 flush gas analysis producing **Gas Chromatograph Alarm**	ΔT<2	ΔT<2	ΔT<2	0	0	None
6-U cooling loop failure (large leak/break/blocked)	Fast (1-2)s drift-up in temperatureto T>50degC. **Siemens Alarm + DCU Alarm.**	**ΔT>50**	**ΔT>50**	ΔT>50	0	0	Pixel Power rampdown.
Supply line failure (small leak)	Small temperature drift. May be detected by N2 flush gas analysis producing **Gas Chromatograph or Mass Spect Alarm**	ΔT<2	ΔT<2	ΔT<2	0	0	None
Supply line failure (large leak/break/blocked)	Fast (1-2)s drift-up in temperatureto T>50degC. **Siemens Alarm + DCU Alarm**	**ΔT>50**	**ΔT>50**	ΔT>50	FLOW	ΔI	Pixel Power rampdown.
Poor contact between frame and pipe.	Plaquette ΔT increases by (1-2) degC	**ΔT<2**	**ΔT<2**	ΔT<2	0	0	None
%Humidity increase	%H increase and **Siemens HMX Sensor Alarm.**	**%H**	0	0	0	0	Check nN2(dry air) supply. Quick switch to backup.
Local HV/LV Dead Short	Plaquette current draw high or trip. Noisey or dead channels. High local heating. **CAEN Overcurrent Alarm.**	ΔT	ΔT	ΔT	0	ΔI	CAEN warning or trip- rampdown of LV/HV to plaquette.
Local HV/LV Leakage Current High	Plaquette increase current draw. Noisey or dead channels. Small local heating. **CAEN Overcurrent Warning.**	ΔT	ΔT	ΔT	0	ΔI	**Turn supply down or off**

Local Alarms

Problem (Local)	Effect	Siemens T / %H	FEC/DCU Temp	FED Temp/Rate	Chiller Flow/Wght	CAEN I-V	Action
Noise/Grounding Loop	Readout problems			NOISE RATE		ΔI	Turn power off to blade.
Delamination of Cooing Loop-SLOW	Rise in panel temperature (10-50) degC. Increase n leakage current. SLOW	ΔT	ΔT	NOISE RATE	0	ΔI	Turn power off to blade if leakage current too high.
Delamination of Cooing Loop-FAST	Rise in panel temperature (10-50) degC. Increase n leakage current. FAST	ΔT	ΔT	NOISE RATE			Turn power off to blade if leakage current too high.
RTD Delamination	RTD changes to ambient temperature. May be difficult to detect. RTD will not follow cool-down or warm-up trend.	ΔT	ΔT	0	0	0	Repair upon access.
Blade Assembly Delamination	SLOW or FAST rise in temperature and leakage current. Allignment constant changes. Noise rate increase.	ΔT	ΔT	NOISE RATE	0	ΔI	
FIRE ALARM - Pixel DAQ	Sprinlers/Halon **DSS**						Power Down Electronic, Leave area immediately.

Global Alarms/DSS

Problem (Global)	Effect	Siemens PLC T / %H	FEC/DCU Temp	FED Temp/Rate	Chiller Flow/Pres	CAEN I-V	Action
Si Tracker - Thermal screen Off or Failure	Small drift-up in plaquette temperature. Added load to Pixel chillers. Radiative cooling of shield. Small increase in current	**ΔT<2**	**ΔT<2**	**ΔT<2**	FLOW	ΔI	Notify Si-Tracker Operations.
Cooling Plant global failure (stop, major leak)	Fast (1-2)s drift-up in temperature to T>50degC. **Siemens T-Alarm + DCU T - Alarm.+ FlowAlarm from Chiller Plant.**	**ΔT>50**	**ΔT>50**	**ΔT>50**	FLOW	ΔI	Pixel Power rampdown.
Major leak in supply lines.	Fast (1-2)s drift-up in temperature to T>50degC. **Siemens Alarm + DCU Alarm.+ FLOW Alarm** from Chiller Plant.	**ΔT>50**	**ΔT>50**	**ΔT>50**	FLOW WGHT	ΔI	Pixel Power rampdown.
Minor leak in supply lines.	Minor temperature rise at detector. **FLOW** loss noticed by Chiller Plant.	0	0	0	FLOW	0	None
High radiation level	Radiation monitors scream with level of warnings and alarms	DOSE	DOSE	0	0	ΔI	SC: will receive notification (DDS?) Handled probably by DDS. Interlock should happen. Beam dump is the ultimate action.
N2 flow failure (stop flowing, no dry)	Notification from the H2 flowing system	0	0	0	0	0	SC: will propagate a notification, IL: ordered ramp-down
Global power cut in the counting room	Slow Control and DAQ on battery backup.						Pixel Power rampdown.
Global power cut in the cavern	Detector power drop. Slow Control and DAQ may be operational. ???	**ΔT**	**ΔT**	**0**	**0**	ΔI	Pixel Power rampdown.
Siemens PLC failure	PLC notification	PLC	0	0	0	0	Immediate Pixel Power Rampdown OR Swap Modules if FED/FEC/CAEN Normal.
Coolant radiation damage or impurity pollution.	Reduced cooling capacity.	**ΔT**	**ΔT**	**ΔT**	FC72	ΔI	Change coolant during shutdown or bleed in freah FC72 for contuinous running.

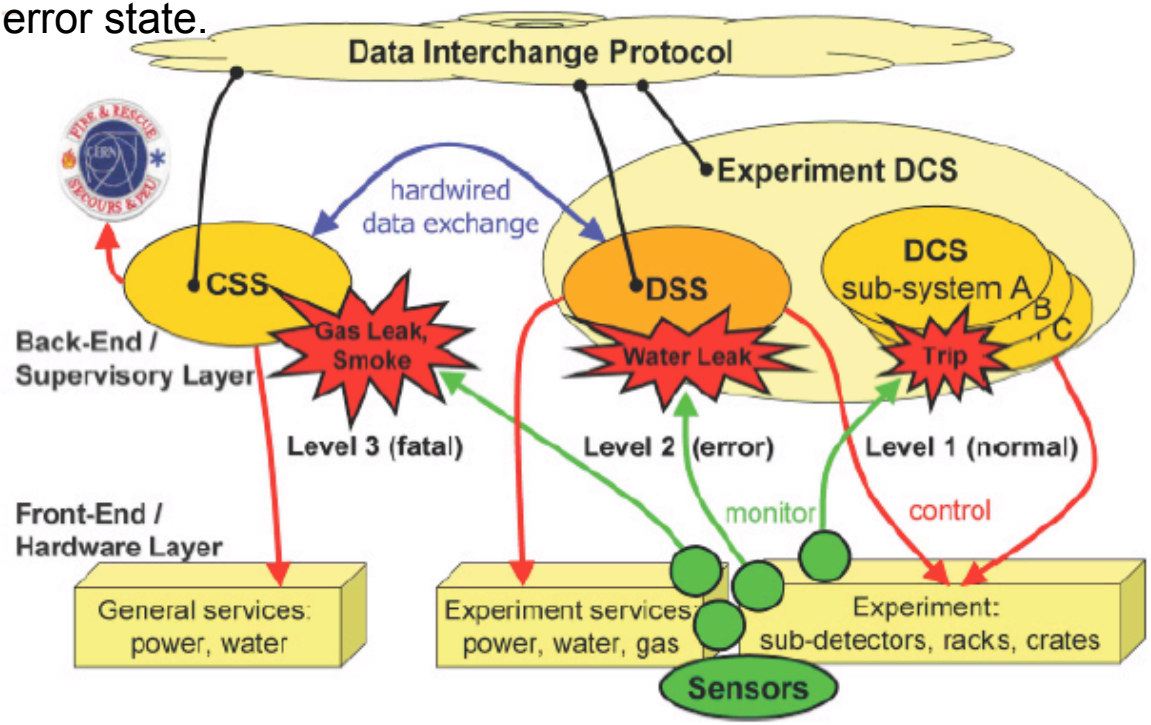
Global Alarms/DSS

Problem (Global)	Effect	Siemens T / %H	FEC/DCU Temp	FED Temp/Rate	Chiller Flow/Wght	CAEN I-V	Action
FIRE ALARM - USC55	Sprinlers/Halon						Power Down Electronics
FIRE ALARM - ELE RACKS	Sprinlers/Halon						Power Down Electronic
FIRE ALARM - Pixel DAQ	Sprinlers/Halon						Power Down Electronic, Leave area immediately.
Solenoid Quench	Current Glitch/ DSS Alarm						Power Down Electronics

DSS

The main goals of a Detector Safety System (DSS) for the experiments at the LHC are to protect the equipment of the experiment, with that the investment into it, and to avoid situations leading to Alarms-of-Level-3 in order to increase the running time of the experiment. It should complement and not duplicate existing systems, such as the Detector Control System (DCS) and the CERN Safety System (CSS).

A 3-level alarm system is to operate.
Level-3) Red indicates a fatal condition, enough fault to shut experimental operations down.
Level-2) Error state indicates operations can continue for all subdetectors, less possibly the subdetector(s) in error state.
Level-1) Normal condition



Action to DSS Alarms

DSS System and Pixels

In this section we take an introspective look at various problems that may affect the Pixel operation and how our DCS would react to DSS alarms.

1) Fire or Smoke Alarm in USC Cavern . DSS system indicates alarm-3.
-Pixel power is turned off by PLC(1sec).

2) Cooling Water Leak (HCAL, etc.). Humidity levels are sensed by HCAL leak detectors and/or the Pixel *%H*. Pixel DCS/DSS system indicate alarm-3.
-Pixel power is turned off by PLC(1sec).
-Coolant flow stopped (1min).

3) %Humidity Level Increase. Pixel DCS/DSS system indicates alarm-2.
-Pixel power is turned off by PLC(1sec).
-Coolant flow stopped (1min).

4) Solenoid Magnet Quench. Some motion of the pixel detector expected.
DSS system indicates alarm-3.
-Pixel power is turned off by PLC(1sec).
-Coolant flow stopped (1min).

5) FC72 Coolant Leak or Failure. DSS system indicates alarm-2. Pixel T-sensors and current monitor preclude DSS here.
-Pixel power is turned off by PLC(1sec).
-Coolant flow stopped (1min).

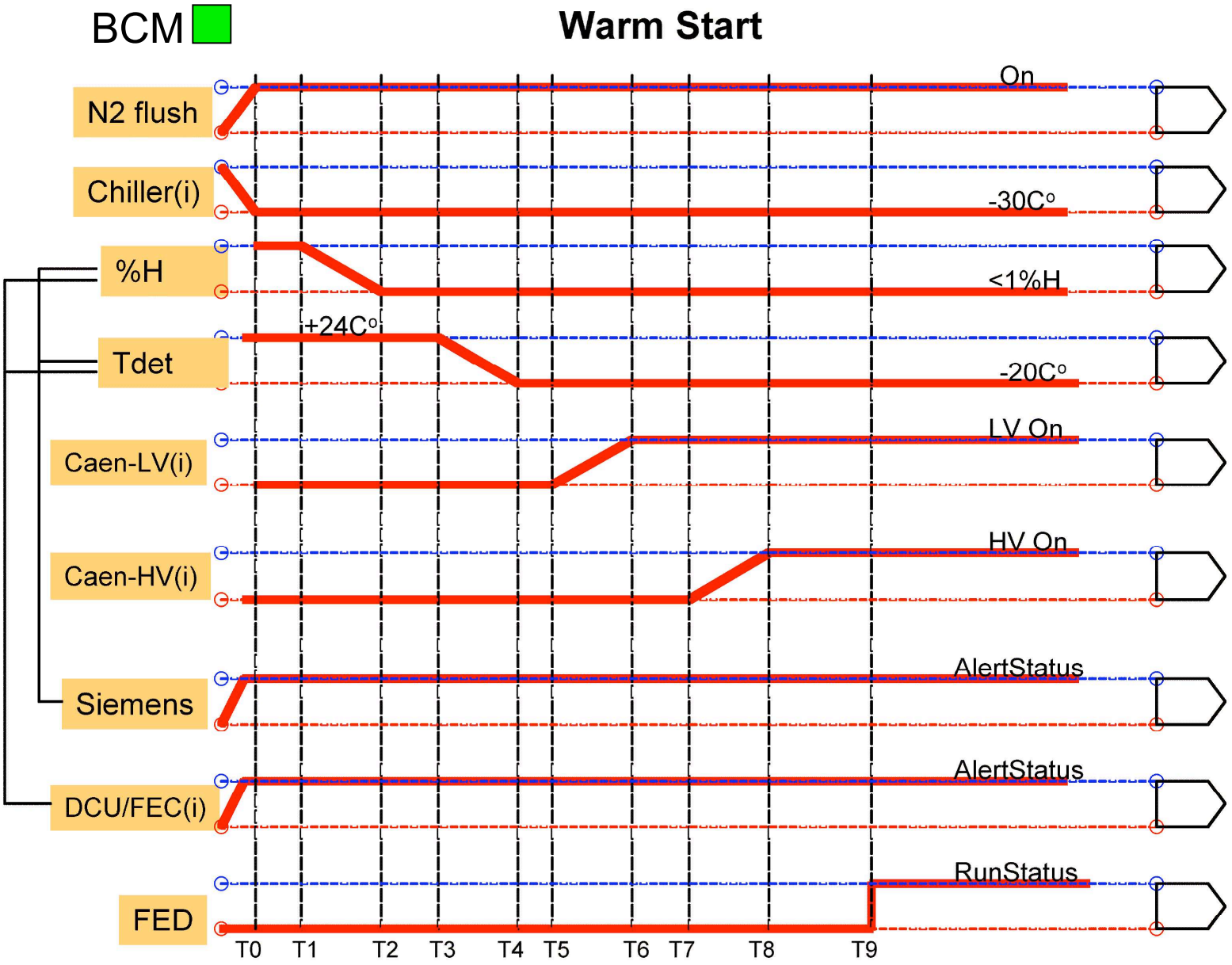
6) Global Power Outage. DSS system indicates alarm-3.
-Pixel power is turned off by PLC(1sec).
-Coolant flow stopped (10min).

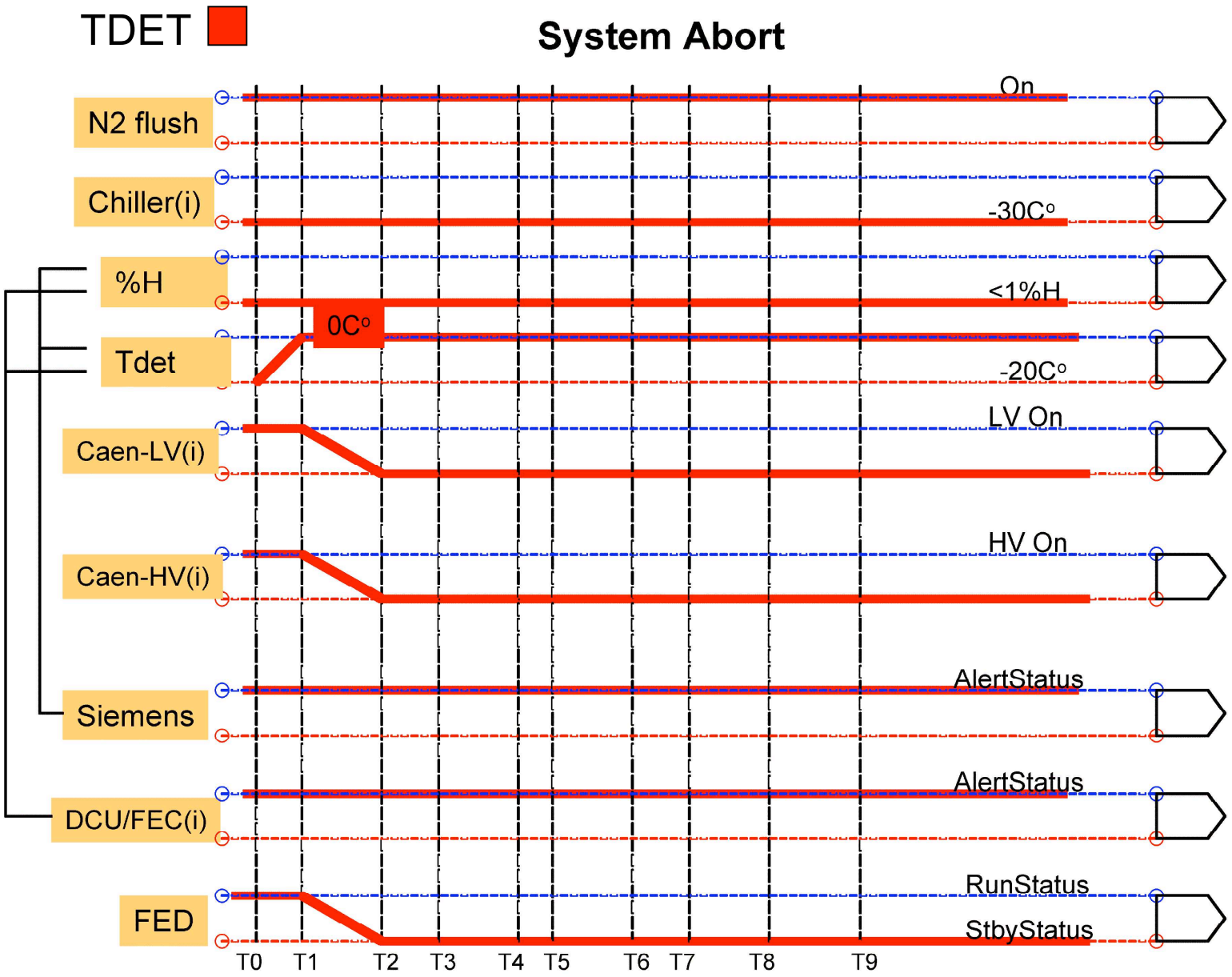
7) Beam pipe/ vacuum comprimised. DSS system indicates alarm-3.
-Pixel power is turned off by PLC(1sec).

8) Hi Beam radiation level. DSS system indicate fault (eg. BCM) .
-Pixel power is turned off by PLC(1sec).

9) Pixel PLC hardware failure.
-Pixel power is turned off by PLC(1sec).

10) Pixel PLC software failure.
-Pixel power is turned off by PLC(1sec).


BCM
Warm Start
N2 flush
On
Chiller(i)
-30C°
%H
<1%H
+24C°
Tdet
-20C°
Caen-LV(i)
LV On
Caen-HV(i)
HV On
Siemens
AlertStatus
DCU/FEC(i)
AlertStatus
FED
RunStatus
T0
T1
T2
T3
T4
T5
T6
T7
T8
T9


TDET
System Abort
N2 flush
Chiller(i)
%H
Tdet
Caen-LV(i)
Caen-HV(i)
Siemens
DCU/FEC(i)
FED
On
-30C°
<1%H
0C°
-20C°
LV On
HV On
AlertStatus
AlertStatus
RunStatus
StbyStatus
T0
T1
T2
T3
T4
T5
T6
T7
T8
T9